System Impact Study Report
Cluster Request GI-2006-1
Portfolio K

Public Service Company of Colorado
All-Source Request for Proposals

Transmission Reliability and Assessment

June 21, 2006

I. Executive Summary

This System Impact Study Report summarizes the supplemental analyses performed by Public Service Company of Colorado (PSCo) Transmission to further evaluate the cluster request GI-2006-1 as requested by the Customer for the 2003 Colorado Least Cost Resource Plan. This study evaluated another subset of generation from the cluster, called Portfolio K. A separate report addresses portfolios A through I, which was posted on the PSCo OASIS on May 25, 2006. There is no portfolio J. The cluster of resources and the portfolios studied are shown in Table 1. Simple figures for each interconnection are shown in Section VIII.

All projects were evaluated as Network Resources, with power going to PSCo customer loads. When modeling the wind projects, it was assumed that other PSCo resources in the vicinity of each wind project would be used to manage any potential transmission limitations. Therefore, costs associated with the wind projects only consist of those associated with Interconnection of the facilities. Table 1 shows the estimated PSCo Network Upgrade costs for Interconnection and Delivery as indicated by the analyses. The table also briefly describes each of the transmission components required for delivery and the date that the upgrades must be implemented in order to fully accommodate the generation. The table does not include customer costs for any of the interconnections. As a result of the new turbine characteristics at the Cedar Creek facility, studies indicated that the bidder must add voltage control equipment at that site in order to meet PSCo interconnection criteria for voltage ride-through capability.

II. Study Scope and Analysis

As part of the PSCo 2003 Least Cost Resource Plan, and subsequent Request for Proposals, multiple bids were evaluated at a feasibility level on a stand-alone basis. From those bids, the Customer identified a smaller cluster of proposals and several portfolios of resources to proceed under the FERC LGIP process. On January 10, 2006 a System Impact Study was initiated. On April 14, 2006, the Customer requested that one additional portfolio be studied. This report summarizes the transmission requirements associated with the proposed interconnections to the PSCo Transmission System for portfolio K.

The Study consisted of power flow, short circuit, and dynamic stability analyses. The power flow analysis identified thermal or voltage limit violations resulting from the interconnection, and identified Network Upgrades required to deliver the proposed generation to PSCo loads. The short circuit analysis identified circuit breaker short circuit capability limits that could be exceeded because of the Interconnection and the delivery of the proposed generation to PSCo loads. The dynamic stability analysis identified any limitations associated with each portfolio due to angular instability of the system for regional disturbances.

Table 1 Portfolio K Summary[1]

Portfolio K Resource Description					In Service Dates		Interconnection Cost
Bid #	Facility	Interconnection	MW	Type	Requested Backfeed	Requested Commercial[2]	$ millions
W009	Logan	Pawnee	400	Wind	12/1/06	12/31/06	$0.56
W014	Twin Buttes	Lamar	75	Wind	1/1/07	3/1/07	$0.00
W022	Cedar Creek	RMEC	300	Wind	7/1/07	11/1/07	$3.29[3]
G004	Plains End	Plains End	115	Gas	2/1/08	5/31/08	$0.69
G029	Spindle	FSV - Valmont	269	Gas	12/1/06	5/31/07	$3.04
G031	Squirrel	Com-DP 345	500	Gas	11/1/08	5/31/09	$8.04
Totals							**$15.62**

Network Upgrades and Costs for Delivery		
Powerflow	**Required In Service Date**	**Delivery Cost $ millions**
Spruce – Smoky Hill: Upgrade the double-circuit 230 kV transmission and termination equipment as needed to achieve a continuous rating of 800 MVA	5/31/07	$2.43
Smoky Hill – Jordan: Upgrade the 230 kV transmission circuits and termination equipment as needed to achieve a continuous rating of 558 MVA.	5/31/07	$0.98
St. Vrain -Leggett/Valmont: Upgrade the double-circuit 230 kV transmission and termination equipment as needed to achieve a continuous rating of 525 MVA.	5/31/07	$2.75
Midway – Waterton: Establish a 345 kV transmission circuit between Midway and Waterton substations. Replace the two 100 MVA 230/115 kV autotransformers at Waterton substation with 280 MVA units. Increase the rating of the Waterton – Littleton 115 kV line from 135 MVA to 217 MVA.	5/31/09	$28.50
Plains End: Tie the generation into both 230 kV transmission circuits (Lookout-Niwot and Lookout-Simms-Valmont) by expanding the existing substation.	5/31/08	$3.24
Plains End – Lookout: Upgrade the double-circuit 230 kV transmission and termination equipment as needed to achieve a continuous rating of 525 MVA.	5/31/08	$0.71
Valmont: Add a 2nd 230/115 kV 280 MVA autotransformer.	5/31/10	$3.74
Daniels Park: Replace the existing 230/115 kV 168 MVA autotransformer at with a 280 MVA unit.	5/31/10	$2.74
Transient Stability (No Upgrades Required)		$0.00
Short Circuit (Replace five 230 kV and ten 115 kV breakers at various locations)		$3.04
Total Delivery Costs		**$48.13**
Total Portfolio K Costs		**$63.75**

[1] Cost figures are in 2006 dollars and include applicable overheads.
[2] Some dates have been modified by the Customer from the original requests.
[3] Due to the wind turbine characteristics, studies demonstrated the need for voltage control equipment in order for the customer to meet PSCo interconnection criteria. The costs of such equipment are the responsibility of the customer and were not estimated.

PSCo adheres to NERC / WECC Reliability Criteria, as well as internal Company criteria for planning studies. During system intact conditions, criteria are to maintain transmission system bus voltages between 0.95 and 1.05 per-unit for system normal conditions, and steady state power flows within 1.0 per-unit of all elements thermal (continuous current or MVA) ratings. Operationally, PSCo tries to maintain a transmission system voltage profile ranging from 1.02 per-unit or higher at generation buses, to 1.0 per-unit or higher at transmission load buses. Following a single contingency element outage, transmission system steady state bus voltages must remain within 0.90 per-unit to 1.10 per-unit. Power flows over 1.0 per-unit of the elements continuous thermal ratings are monitored and evaluated to determine potential network upgrades. The NERC / WECC Planning Standards for System Performance were also followed for the stability analysis. In the WECC Disturbance-Performance criteria, for the loss of a single element (line or transformer), the maximum allowed voltage dip after fault clearing is 25% for load buses. This dip cannot exceed 20% for more than 20 cycles. The allowed post-transient voltage deviation, 1 to 3 minutes after the fault, is 5% for all buses. In addition, the frequency at any bus cannot be below 59.6 Hz for more than 6 cycles.

The proposed transmission for delivery alleviates potential impacts to regional utilities in the area of study that would be associated with the interconnections. These results have been shared with Aquila, Arkansas River Power Authority, Colorado Springs Utilities, Platte River Power Authority, Tri-State Generation and Transmission, and Western Area Power Administration.

At the time of this study, there were no active LGIP requests in the PSCo Generator Interconnection Queue. Therefore, this study did not have to consider any other higher queued projects.

III. Modeling

Refer to the Portfolio A-I report for more details on system modeling posted on the PSCo OASIS in Transmission Studies. Peak summer 2008 and 2010 models were used for studies.

On May 30, 2006, the Customer communicated that project W022 would have different wind turbines than what were originally proposed by the bidder. The initial proposal was for 200 GE 1.5 MW wind turbines. The revision to the proposal is for 180 Mitsubishi 1.0 MW wind turbines and 80 GE 1.5 MW units. The Mitsubishi turbines are induction machines that do not appear to have the electronics that other turbines have to control and maintain voltages. Characteristics for this change were modeled in transient stability studies.

IV. Steady State Results

The steady-state analysis evaluated the impact that the addition of a portfolio of resources would have on the existing transmission system compared to benchmark performance using existing generating resources available to PSCO. This process

utilized contingency analysis to evaluate transmission system behavior with all facilities in service and its response under single contingency (N-1) conditions. The impacts of these portfolio resources were measured in terms of overloaded facilities or voltage changes outside of allowable boundaries.

The steady state analysis revealed several network upgrades that would be required to accommodate portfolio K. The following sections describe each network upgrade.

A. Spruce – Smoky Hill 230 kV Transmission Uprate

This study showed that for portfolio K, this path exhibited the potential for significant contingency overloads. The most severe contingency is the loss of one of the Spruce – Smoky Hill 230 kV circuits, leading to unacceptable loading on the remaining parallel circuit. The 2008 overloads were about 43%, corresponding to 12% higher loadings than in the benchmark case.

It is recommended that each circuit of the Spruce – Smoky Hill double-circuit 230 kV transmission, and termination equipment, be upgraded to achieve a continuous rating of 800 MVA by May 31, 2007.

B. Smoky Hill – Jordan 230 kV Transmission Uprate

This path exhibited the potential for significant contingency overloads. Studies of the 2008 system showed that for certain contingencies there were potential loadings on the three series circuits of the Smoky Hill – Jordan 230 kV path of up to 45% of their continuous ratings.

It is recommended that the entire 230 kV transmission line between Smoky Hill and Jordan, and termination equipment, be upgraded to achieve continuous rating of 558 MVA by May 31, 2007.

C. St. Vrain – Valmont/Leggett 230 kV Transmission Uprate

Implementation of project G029, near Frederick, resulted in contingency overloads on the 230 kV transmission between St. Vrain and Niwot, and St. Vrain and Valmont. The most severe contingency in the 2008 models is the loss of one of the 230 kV circuits, leading to unacceptable loading on the remaining parallel circuit. Contingency overloads ranged from 14 –25% of the continuous ratings, which are up to about 20% higher than benchmark conditions.

It is recommended that the 230 kV double-circuit transmission between St. Vrain and Leggett/Valmont, and termination equipment, be upgraded to achieve a continuous rating of 525 MVA by May 31, 2007.

D. Midway – Waterton 345 kV Addition and Associated Upgrades

Studies using 2010 system models indicated significant contingency overloads on the transmission systems that belong to Colorado Springs Utilites (CSU), Aquila, and Mountain View Electric Association, due to adding the G031 Squirrel generation. To alleviate the potential overloads and accommodate the new generation, the following network upgrades are recommended to be implemented by May 31, 2010:

1. Establish a 345 kV transmission circuit between Midway and Waterton substations.
2. Replace the two 100 MVA 230/115 kV autotransformers at Waterton substation with 280 MVA units.
3. Increase the rating of the Waterton – Littleton 115 kV line from 135 MVA to 217 MVA.

The 2010 models included the Comanche – Daniels Park 345 kV Transmission Project, which is scheduled to be in service by the spring of 2009. Any delays in the Comanche – Daniels Park Project could result in the inability to fully accommodate the G031 Squirrel generation by its planned in-service date.

E. Plains End Bus Tie

In the 2008 studies of portfolio K, studies show that the loss of the Valmont 230/115 kV transformer resulted in a 40% overload on the Lookout – Plains End 230 kV circuit, or about 46% above benchmark loading. Studies showed that the contingencies could be alleviated by tying the two 230 kV transmission circuits together at the Plains End interconnection.

It is recommended that the existing Plains End switching station be expanded to sectionalize the Lookout to Niwot 230kV transmission line at Plains Ends, which allows two 230 kV transmission circuits to be connected at that point by May 31, 2008.

F. Plains End – Lookout 230 kV Transmission Upgrade

Studies of the 2008 system showed advantages to tying the 230 kV transmission circuits at Plains End. However, the bus tie resulted in potential contingency overloads of either of the Plains End – Lookout 230 kV circuits for loss of the parallel circuit of up to 34%.

It is recommended that the both Plains End - Lookout 230 kV transmission circuits (created by tying the two circuits at Plains End) and termination equipment, be upgraded to achieve a continuous rating of 525 MVA by May 31, 2008.

G. 2nd 230/115 kV 280 MVA Autotransformer at Valmont

Studies of the 2010 system that modeled heavy north to south flows revealed potential overloads of up to 24% on the existing unit for a loss of the Simms to Valmont 230 kV transmission line, corresponding to a 38% increase over benchmark conditions.

It is recommended that the second 280 MVA Autotransformer be added at Valmont by May 31, 2010.

H. Daniels Park 230/115 kV Autotransformer Replacement

Studies of the 2010 system that modeled heavy north to south flows indicated the potential for the existing 150 MVA autotransformer at Daniels Park to experience contingency overloads of up to 24% for a loss the Parker – Bayou 115 kV line.

It is recommended that the existing autotransformer be replaced with a 280 MVA unit by May 31, 2010.

V. Transient Stability Results

Transient stability results for portfolio K were similar to those of portfolios A-I, except for one area. When modeling the Mitsubishi units at Cedar Creek, about 50 MVARs of reactive support had to be added to the base case in order to have adequate voltages at the collector bus prior to any disturbance modeling.

As a result of the turbine characteristics at the Cedar Creek facility, studies indicated that additional voltage control equipment would be required in order to meet PSCo interconnection criteria for voltage ride-through capability. For faults on the PSCo system near the point of interconnection, the voltage drop at the W022 site is such that the Mitsubishi units will trip with voltage levels at the collector buses falling below 0.75 per unit. Other than the loss of this generation, system voltage performance within the PSCo system is comparable to that observed for other portfolios. No attempt has been made to determine the reactive support needed at the developer site to maintain the W022 facility on line during disturbances.

VI. Short Circuit Results

The short circuit analysis consisted of faulting buses at or near the points of interconnection of the portfolio generation. Three-phase and single-line to ground faults were evaluated and the three-phase faults were found to be more severe. Breakers that were approaching their maximum fault duty were documented. Ten 115 kV and five 230 kV breakers were identified for replacement. The estimated cost for replacement of those breakers is approximately $3.04 million. In some locations, other viable options to breaker replacement continue to be evaluated and may be described in subsequent facilities studies.

VII. PSCo Cost Estimates and Assumptions

A. Network Upgrades for Interconnection (Figures are shown in Section VIII)

1. W009

Element	Description	Cost ($ Millions)
Pawnee Switching Station	Upgrade Pawnee 230kV substation to interconnect the facility. The new equipment required includes: • One 230 kV 3000 amp 50 kA circuit breaker • Miscellaneous equipment	**$0.560**
	Siting & Land Rights	**N/A**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$0.560**
Time Frame	**Months Estimated for Construction**	**9 months**

2. W014

Element	Description	Cost ($ Millions)
Colorado Green Switching Station	• No changes required	**$0.00**
	Siting & Land Rights	**N/A**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**N/A**
Time Frame	**Months Estimated for Construction**	**N/A**

3. W022

Element	Description	Cost ($ Millions)
New Switching Station	Construct a 230kV substation that will sectionalize only one RMEC – Green Valley 230 kV line and interconnect the Customer's 230 kV line to the Project. The equipment required includes: • Site development and land • Control building • Three (3) 230 kV 3000 amp 40 kA circuit breakers	**$2.916**
	Transmission Line Tap Structures and Line	**$0.077**
	Siting & Land Rights	**$0.298**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$3.291**
Time Frame	**Months Estimated for Construction**	**24 months**

4. G004

Element	Description	Cost ($ Millions)
Plains End Switching Station	Upgrade Plains End 230kV substation to interconnect the facility. The equipment required includes: • One (1) 230 kV 3000 amp 40 kA circuit breaker • 230 kV metering units	**$0.612**
	Transmission Line Tap Structures and Line	**$0.077**
	Siting & Land Rights	**N/A**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$0.689**
Time Frame	**Months Estimated for Construction**	**12 months**

5. G029

Element	Description	Cost ($ Millions)
New PSCo Spindle Switching Station	Construct Spindle 230kV substation to interconnect the facility. The equipment required includes: • Three (3) 230 kV 3000 amp 40 kA circuit breaker • Site development and land • Control building	**$2.644**
	Transmission Line Tap Structures & Tap	**$0.077**
	Siting & Land Rights	**$0.317**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$3.038**
Time Frame	**Months Estimated for Construction**	**24 months**

6. G031

Element	Description	Cost ($ Millions)
New PSCo 345 kV Switching Station	Construct a new PSCo 345 kV ring bus substation that will sectionalize the PSCo Comanche – Daniels Park 345 kV operated line and interconnect the Customer's 345 kV line to the Project. The equipment required includes: • Site development and land • Control building • Four (4) 345 kV 3000 amp 40 kA circuit breakers	**$7.479**
	Transmission Line Tap Structures & Tap	**$0.115**
	Siting & Land Rights	**$0.450**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$8.044**
Time Frame	**Months Estimated for Construction**	**27 months**

B. PSCo Network Upgrades for Delivery Cost Estimates (Section IX shows a general geographic depiction of the upgrades)

1. Spruce – Smoky Hill

Facility	Description	Cost $ Millions
Spruce Substation	No changes required	**N/A**
Smoky Hill Substation	Modify the Smoky Hill Substation to allow an 800 MVA continuous rating on the Spruce – Smoky Hill 230 kV double circuit transmission. The following equipment will be required: • Five (5) 230 kV 3000 amp 40 kA circuit breakers	**$2.237**
Time Frame	**Months - Substation**	**12 months**
Transmission	Modify the existing 230 kV transmission line between Smoky Hill and Spruce substations to achieve an 800 MVA continuous rating. • Add extensions on tangent structures	**$0.195**
Time Frame	**Months - Transmission**	**4 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**N/A**
Time Frame	**Months– S & LR**	**N/A**
Total Cost	**Total Estimated Cost for Network Upgrades for Delivery**	**$2.432**
Time Frame	**Months Estimated for Construction**	**12 months**

2. Smoky Hill – Jordan

Facility	Description	Cost $ Millions
Meadow Hill Substation	Modify the Meadow Hill Substation to allow 558 MVA continuous rating on the Smoky Hill to Jordan 230 kV transmission. The following equipment will be required: • Replace one (1) 230 kV switch	**$0.050**
Orchard Substation	Modify the Orchard Substation to allow 558 MVA continuous rating on the Smoky Hill to Jordan 230 kV transmission. The following equipment will be required: • Replace three (3) 230 kV switch	**$0.150**
Time Frame	**Months - Substation**	**6 months**
Transmission	Increase the continuous rating of the Smoky to Jordan 230 kV transmission line to 558 MVA. The following equipment will be required: • Remove existing Qwest shield wire and bury new shield wire • Replace one (1) steel pole and lower street lights	**$0.760**
Time Frame	**Months - Transmission**	**6 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**$0.02**
Time Frame	**Months– S & LR**	**2 months**
Total Cost	**Total Cost for Network Upgrades for Delivery**	**$0.980**
Time Frame	**Months– Network Upgrades**	**8 months**

3. St. Vrain – Valmont /Leggett 230kV Uprate

Facility	Description	Cost $ Millions
Ft. St. Vrain Switchyard	Modify the Fort St. Vrain Switchyard to allow 525 MVA continuous rating on the St. Vrain to Valmont/Leggett 230 kV double circuit transmission. The following equipment will be required: • Six (6) 230 kV 3000 amp 40 kA circuit breakers • 230 kV metering units	**$1.127**
Leggett Substation	Minor substation upgrades required to achieve the desired rating on the St. Vrain to Valmont/Leggett 230 kV double circuit lines: • Replace jumpers	**$0.024**
Time Frame	**Months - Substation**	**10 months**
Transmission	Increase the continuous rating of the St. Vrain to Valmont/Leggett 230 kV transmission line to 525 MVA. The following equipment will be required: • Replace/add cage extensions • Replace tangent poles and steel dead end structures	**$1.567**
Time Frame	**Months - Transmission**	**8 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**$0.030**
Time Frame	**Months– S & LR**	**2 months**
Total Cost	**Total Estimated Cost for Network Upgrades for Delivery**	**$2.748**
Time Frame	**Months– Network Upgrades**	**12 months**

4. Plains End Bus Tie

Facility	Description	Cost $ Millions
Plains End Switchyard	Modify the Plains End Switchyard to sectionalize the Plains End - Lookout 230 kV circuit transmission. The following equipment will be required: • Five (5) 230 kV 3,000 amp 40kA circuit breakers • Seven (7) 230kV gang switches • Associated foundations and structures	**$1.723**
Niwot Substation	Upgrade the Niwot substation to accommodate the Plains End Tap project • Miscellaneous	**$0.078**
Lookout Substation	Upgrade the Lookout substation to accommodate the Plains End Tap project • Miscellaneous	**$0.078**
	Months - Substation	**12 months**
Transmission	Construct a new 230kV Tap, double circuit line into Plains End 230kV Switching Station.	**$1.255**
Time Frame	**Months - Transmission**	**12 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**$0.107**
Time Frame	**Months– S & LR**	**6 months**
Total Cost	**Total Cost for Network Upgrades for Delivery**	**$3.241**
Time Frame	**Months– Network Upgrades**	**12 months**

5. Plains End – Lookout 230 kV Uprate

Facility	Description	Cost $ Millions
Niwot Switchyard	Modify the Niwot Switchyard to allow 525 MVA continuous rating on the Plains End - Lookout 230 kV double circuit transmission. The following equipment will be required: • Communication equipment, line trap 2,000 amp • Transmission line relaying and testing	**$0.135**
Lookout Substation	Modify the Lookout Switchyard to allow 525 MVA continuous rating on the Plains End - Lookout 230 kV double circuit transmission. The following equipment will be required: • Replance six (6) gang switches • Install 5" Aluminum bus	**$0.381**
Time Frame	**Months - Substation**	**6 months**
Transmission	Increase the continuous rating of the Plains End – Lookout 230 kV transmission lines to 525 MVA. The following equipment will be required: • Replace structures and Dead Ends	**$0.173**
Time Frame	**Months - Transmission**	**6 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**$0.021**
Time Frame	**Months– S & LR**	**6 months**
Total Cost	**Total Estimated Cost for Network Upgrades for Delivery**	**$0.710**
Time Frame	**Months– Network Upgrades**	**6 months**

6. 2nd 230/115 kV 280 MVA autotransformer at Valmont

Facility	Description	Cost $ Millions
Valmont Switchyard	Modify the Valmont Switchyard to allow installation of a 2nd 230/115 kV 280 MVA autotransformer. The following equipment will be required: • One (1) 230/115 kV 280 MVA autotransformer • Fence relocation with bus and underground work	**$3.741**
Time Frame	**Months - Substation**	**18 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**N/A**
Time Frame	**Months– S & LR**	**N/A**
Total Cost	**Total Estimated Cost for Network Upgrades for Delivery**	**$3.741**
Time Frame	**Months– Network Upgrades**	**18 months**

7. 230/115 kV 280 MVA autotransformer at Daniels Park

Facility	Description	Cost $ Millions
Daniels Park Switchyard	Modify the Daniels Park Switchyard to allow replacement of the existing 230/115 kV 168 MVA autotransformer with a 280 MVA unit. The following equipment will be required: • One (1) 230/115 kV 280 MVA autotransformer	**$2.742**
Time Frame	**Months - Substation**	**18 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**N/A**
Time Frame	**Months– S & LR**	**N/A**
Total Cost	**Total Estimated Cost for Network Upgrades for Delivery**	**$2.742**
Time Frame	**Months– Network Upgrades**	**18 months**

8. Midway – Waterton 345kV and Associated Transmission

Facility	Description	Cost $ Millions
Midway 345 kV Substation	Install a new 345kV substation, set up for a Breaker-and-Half configuration, which will interconnect with the existing Midway 230kV Substation via one 345/230kV autotransformer.	**$5.459**
Waterton 345 kV Substation	Install a new 345kV substation, set up for a Breaker-and-Half configuration, which will interconnect with the existing Waterton 230kV Substation via one 345/230kV autotransformer.	**$5.922**
Tarryall 230 kV Substation	Install new 230kV line terminal to sectionalize the 230kV Tarryall to Daniels Park 230kV transmission line at Waterton.	**$1.808**
Time Frame	**Months - Substations**	**18 months**
Waterton to Daniels Park New double circuit 345kV Transmission Line	Install new double circuit 345kV constructed transmission line from the Waterton Substation to the Daniels Park Substation (approx. 9 miles). Bundled 954 kcmil "Cardinal" conductor on tubular steel poles with foundations. One circuit operated at 345kV and one operated at 230kV. New transmission line to be built within existing ROW	**$7.868**
Sectionalize the Tarryall to Daniels Park 230kV Trans. Line	Install necessary transmission line equipment to sectionalize the Tarryall to Daniels Park 230kV transmission line at Waterton Substation.	**$0.565**
Waterton 230kV Substation	Replace two 230/115kV autotransformers with new 230/115kV, 280 MVA autotransformers.	**$6.682**
Waterton to Littleton 115kV Trans Line	Minor transmission line upgrades to uprate 115kV transmission line to 217 MVA continuous rating.	**$0.090**
Time Frame	**Months - Transmission**	**14 months**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, acquisition & permitting.	**$0.108**
Time Frame	**Months– S & LR**	**18 months**
TOTAL	**Total Estimated Cost for Network Upgrades for Delivery**	**$28.502**
TOTAL	**Months– Network Upgrades**	**36 months**

C. Assumptions:

1. The estimated costs provided are "Scoping Estimates" with an accuracy of ± 30%.
2. All applicable overheads are included.
3. There is no contingency added to the estimates.
4. Estimates were not escalated and are in 2006 dollars.
5. PSCo (or its contractor) crews will perform all construction and wiring associated with PSCo-owned and maintained equipment.
6. Timeline and cost estimates assume permits, substation land, and right-of-way, as needed, will be available within typical costs and time frames.
7. The delivery infrastructure cost reflects the assumption that generation re-dispatch on PSCo's system was utilized to accommodate the wind generation projects in this portfolio. The delivery infrastructure cost would increase significantly if wind and existing generation were both accommodated.
8. It is assumed that a Certificate of Public Convenience and Necessity (CPCN) will not be required for any of the Network Upgrades for Interconnection. If the CPUC determines that a CPCN is required for any of the interconnections, the schedule will have to be re-evaluated to determine the extent of the resulting delays.
9. It is anticipated that a CPCN will be required from the CPUC for the network upgrades required for delivery for the Midway – Waterton 345 kV Transmission. The application for a CPCN will not be submitted until after an Interconnection Agreement has been executed.
10. It is assumed that a Certificate of Public Convenience and Necessity (CPCN) will not be required for any of the other (than Midway – Waterton) Network Upgrades for Delivery. If the CPUC determines that a CPCN is required for any of the recommended upgrades for Delivery, the schedules will have to be re-evaluated to determine the extent of the resulting delays.
11. Some public involvement will be required for the network upgrades required for delivery. Land use permits will be required from several local jurisdictions. Permitting could be difficult and potentially controversial.
12. All required transmission outages necessary to support construction will be obtained as needed.

VIII. Figures for Interconnection

Note that the "Customer Facilities" are shown to indicate the Point of Interconnection with PSCo, and may not fully represent the extent of the facilities.

Figure 1 Interconnection for W009

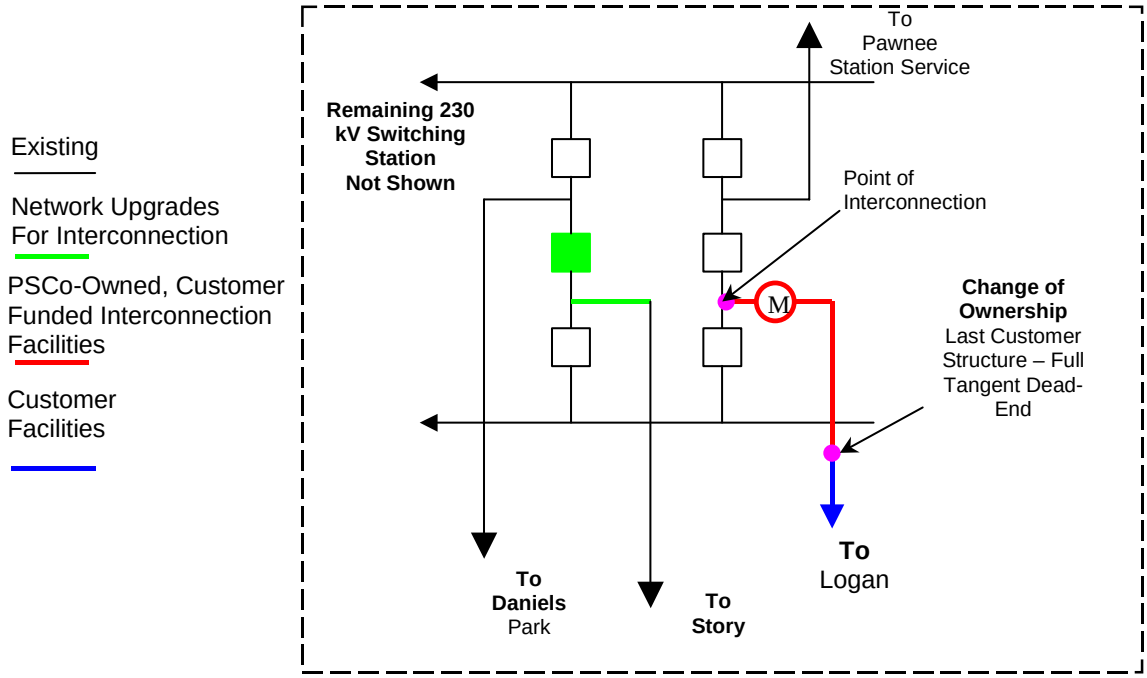


Figure 2 Interconnection W014

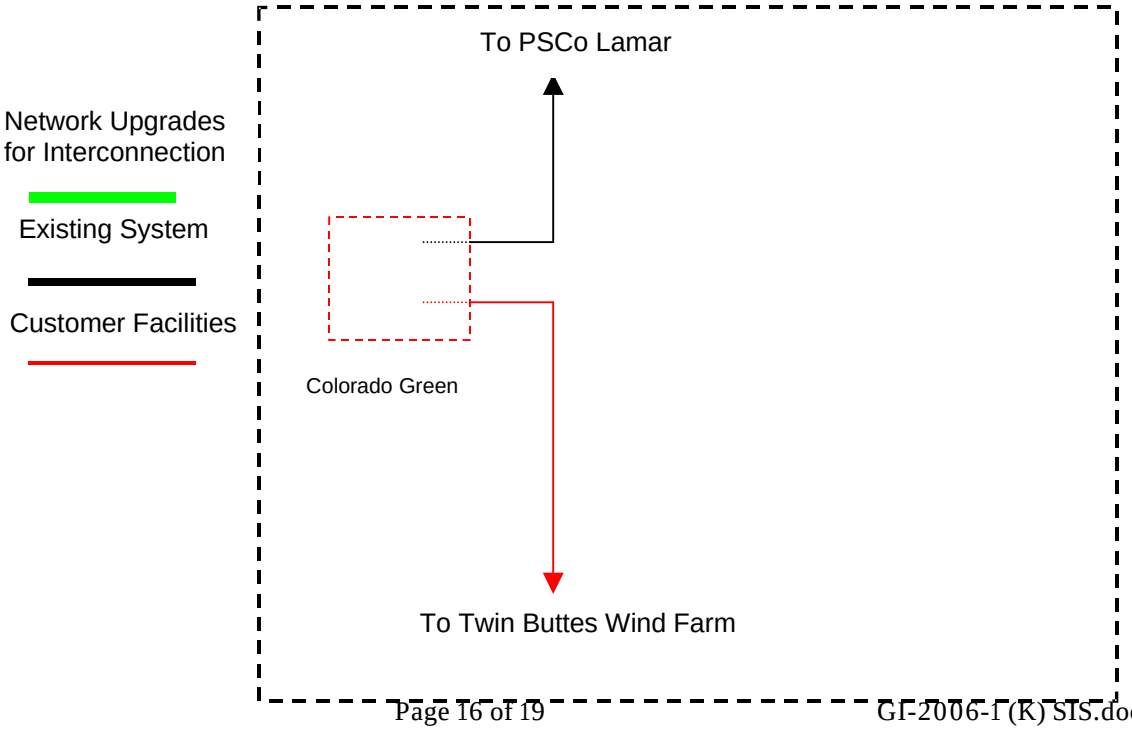


Figure 3 Interconnection for W022

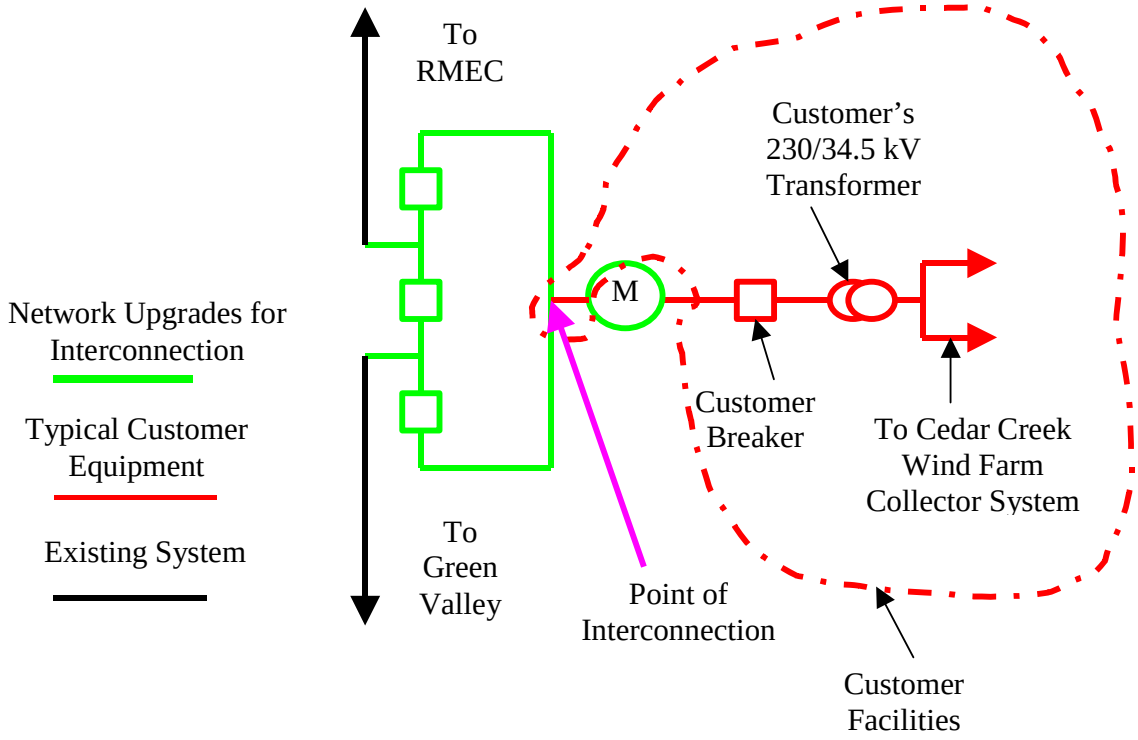


Figure 4 Interconnection for G004

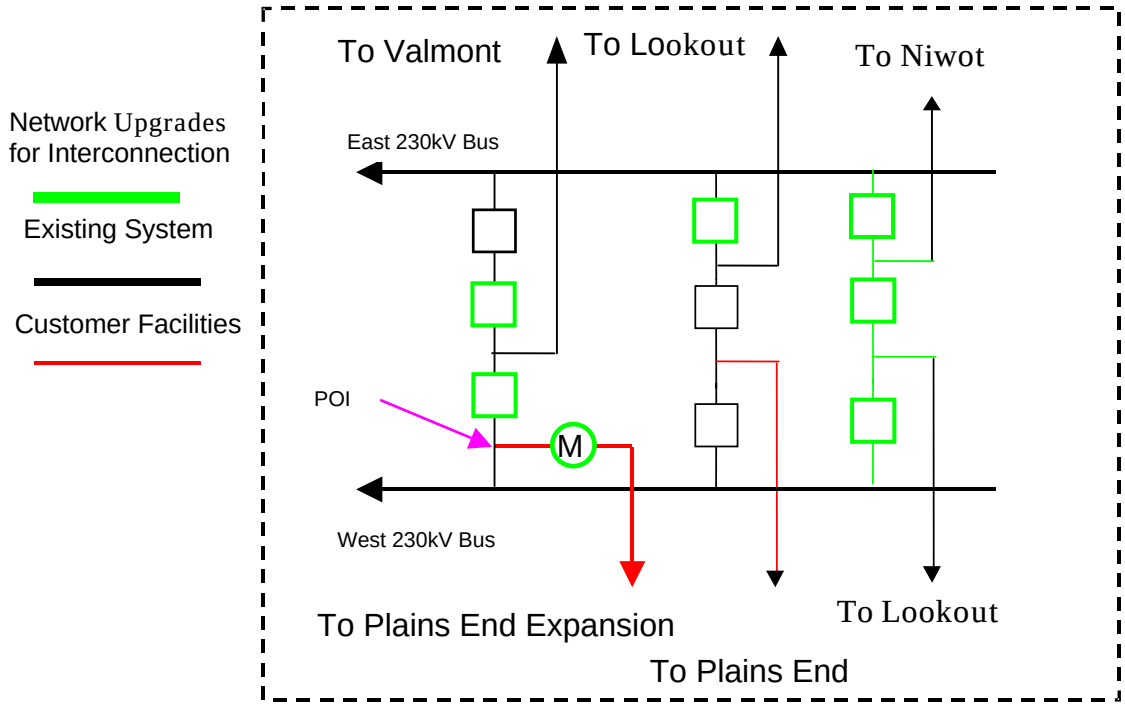


Figure 5 Interconnection for G029

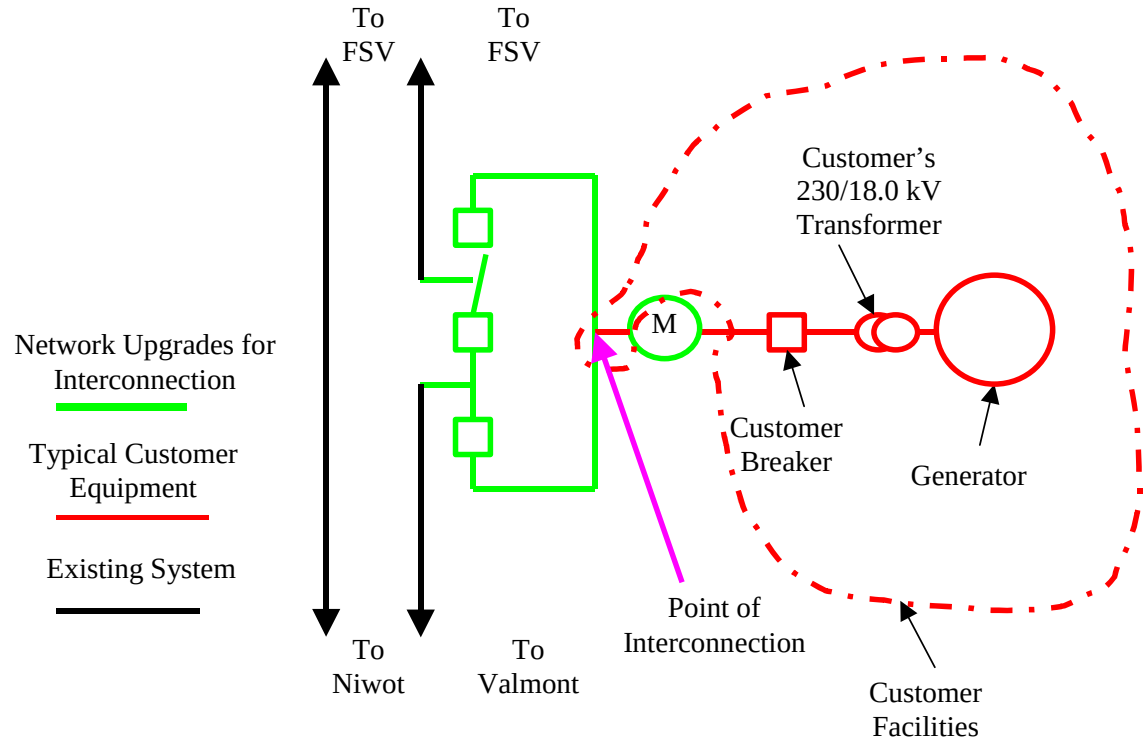
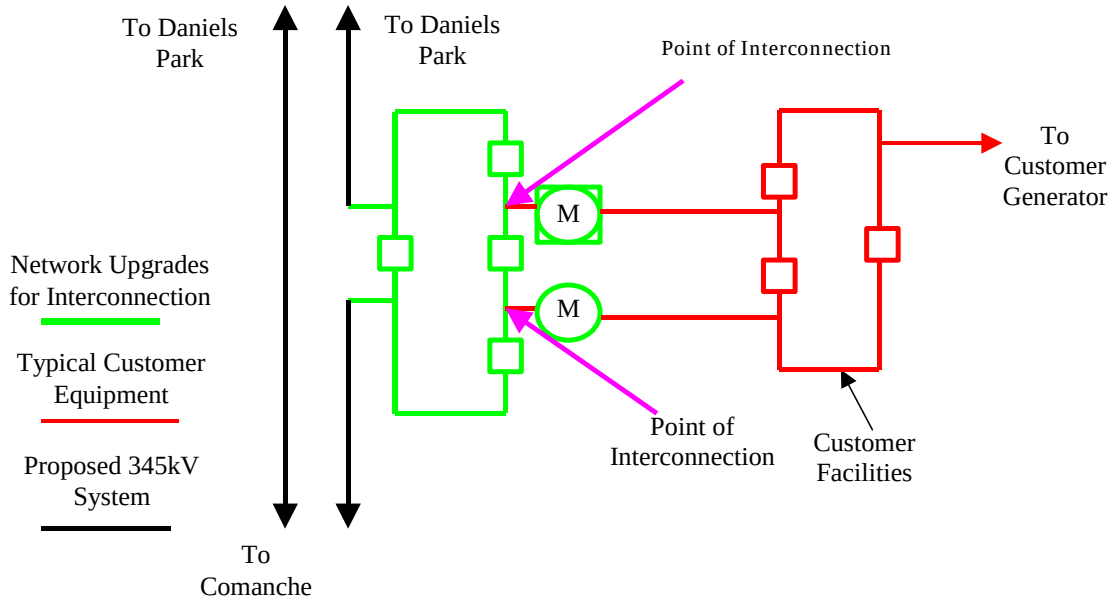


Figure 6 Interconnection for G031



IX. Figure for Network Upgrades for Delivery

Figure 7 General Locations of Network Upgrades for Delivery